The Biological Effectiveness of Different Radiation Qualities for the Induction of Chromosome Damage in Human Lymphocytes

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Chromosome aberrations were measured in human peripheral blood lymphocytes after *in vitro* exposure to ^{28}Si-ions with energies ranging from 90 to 600 MeV/u, ^{48}Ti-ions with energies ranging from 240 to 1000 MeV/u, or to ^{56}Fe-ions with energies ranging from 200 to 5,000 MeV/u. The LET of the various Si beams in this study ranged from 48 to 158 keV/µm, the LET of the Ti ions ranged from 107 to 240 keV/µm, and the LET of the Fe-ions ranged from 145 to 440 keV/µm. Doses delivered were in the 10- to 200-cGy range. Dose-response curves for chromosome exchanges in cells at first division after exposure, measured using fluorescence *in situ* hybridization (FISH) with whole-chromosome probes, were fitted with linear or linear-quadratic functions. The relative biological effectiveness (RBE) was estimated from the initial slope of the dose-response curve for chromosome damage with respect to γ-rays. The estimates of RBE_{max} values for total chromosome exchanges ranged from 4.4±0.4 to 31.5±2.6 for Fe ions, 21.4±1.7 to 28.3±2.4 for Ti ions, and 11.8±1.0 to 42.2±3.3 for Si ions. The highest RBE_{max} value for Fe ions was obtained with the 600 MeV/u beam, the highest RBE_{max} value for Ti ions was obtained 1000 MeV/u beam, and the highest RBE_{max} value for Si ions was obtained with the 170 MeV/u beam. For Si and Fe ions the RBE_{max} values increased with LET, reaching a maximum at about 180 keV/µm for Fe and about 100 keV/µm for Si, and decreasing with further increase in LET. Additional studies for low doses ^{28}Si-ions down to 0.02 Gy will be discussed.